8. **a)** $10^7 = 10\,000\,000$

b) $10^2 = 100$

c) $10^0 = 1$

d) $10^{10} = 10\,000\,000\,000$

e) $10^1 = 10$

f) $10^6 = 1\,000\,000$

9. **a)** $6\,000\,000\,000 = 6 \times 1\,000\,000\,000$
$= 6 \times 10^9$

b) $200 = 2 \times 100$
$= 2 \times 10^2$

c) Use a place-value chart.

Ten thousands	Thousands	Hundreds	Tens	Ones
5	1	4	1	5

$51\,415 = 50\,000 + 1000 + 400 + 10 + 5$
$= (5 \times 10\,000) + (1 \times 1000) + (4 \times 100) + (1 \times 10) + (5 \times 1)$
$= (5 \times 10^4) + (1 \times 10^3) + (4 \times 10^2) + (1 \times 10^1) + (5 \times 10^0)$

d) Use a place-value chart.

Ten millions	Millions	Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Ones
6	0	7	0	2	0	0	8

$60\,702\,008 = 60\,000\,000 + 700\,000 + 2000 + 8$
$= (6 \times 10\,000\,000) + (7 \times 100\,000) + (2 \times 1000) + (8 \times 1)$
$= (6 \times 10^7) + (7 \times 10^5) + (2 \times 10^3) + (8 \times 10^0)$

e) Use a place-value chart.

Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Ones
3	0	2	4	1	1

$302\,411 = 300\,000 + 2000 + 400 + 10 + 1$
$= (3 \times 100\,000) + (2 \times 1000) + (4 \times 100) + (1 \times 10) + (1 \times 1)$
$= (3 \times 10^5) + (2 \times 10^3) + (4 \times 10^2) + (1 \times 10^1) + (1 \times 10^0)$

f) Use a place-value chart.

Millions	Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Ones
2	0	0	0	0	0	8

$2\,000\,008 = 2\,000\,000 + 8$
$= (2 \times 1\,000\,000) + (8 \times 1)$
$= (2 \times 10^6) + (8 \times 10^0)$

10. a) $7 \times 10^7 = 7 \times 10\,000\,000$
$= 70\,000\,000$

b) $(3 \times 10^4) + (9 \times 10^3) + (5 \times 10^1) + (7 \times 10^0)$
$= (3 \times 10\,000) + (9 \times 1000) + (5 \times 10) + (7 \times 1)$
$= 30\,000 + 9000 + 50 + 7$
$= 39\,057$

c) $(8 \times 10^8) + (5 \times 10^5) + (2 \times 10^2)$
$= (8 \times 100\,000\,000) + (5 \times 100\,000) + (2 \times 100)$
$= 800\,000\,000 + 500\,000 + 200$
$= 800\,500\,200$

d) $(9 \times 10^{10}) + (8 \times 10^9) + (1 \times 10^0)$
$= (9 \times 10\,000\,000\,000) + (8 \times 1\,000\,000\,000) + (1 \times 1)$
$= 90\,000\,000\,000 + 8\,000\,000\,000 + 1$
$= 98\,000\,000\,001$

e) $1 \times 10^{15} = 1 \times 1\,000\,000\,000\,000\,000$
$= 1\,000\,000\,000\,000\,000$

f) $(4 \times 10^3) + (1 \times 10^0) + (9 \times 10^5) + (3 \times 10^1)$
$= (4 \times 1000) + (1 \times 1) + (9 \times 100\,000) + (3 \times 10)$
$= 4000 + 1 + 900\,000 + 30$
$= 900\,000 + 4000 + 30 + 1$
$= 904\,031$

11. 500 million $= 500\,000\,000$
$= 5 \times 100\,000\,000$
$= 5 \times 10^8$

$40\,000 = 4 \times 10\,000$
$= 4 \times 10^4$

3 million $= 3\,000\,000$
$= 3 \times 1\,000\,000$
$= 3 \times 10^6$

$17\,000 = (1 \times 10\,000) + (7 \times 1000)$
$= (1 \times 10^4) + (7 \times 10^3)$

$130\,000 = (1 \times 100\,000) + (3 \times 10\,000)$
$= (1 \times 10^5) + (3 \times 10^4)$

$600 = 6 \times 100$
$= 6 \times 10^2$

12. Negative bases may vary.

For example: I chose (–3).

Exponent	Power	Standard Form
5	$(-3)^5$	–243
4	$(-3)^4$	81
3	$(-3)^3$	–27
2	$(-3)^2$	9
1	$(-3)^1$	–3
0	$(-3)^0$	1

Each number in standard form is $-\frac{1}{3}$ of the number before it; that is, divide each number by –3 to get the next number. The standard form of $(-3)^1$ is –3 so for the next power, $(-3)^0$, we divide –3 by –3:

$(-3)^0 = \frac{-3}{-3} = 1$.

13. Write each number in standard form and compare.

a) $(4 \times 10^3) + (6 \times 10^2) + (6 \times 10^1) + (7 \times 10^0)$
= $(4 \times 1000) + (6 \times 100) + (6 \times 10) + (7 \times 1)$
= 4000 + 600 + 60 + 7
= 4667
4667 is greater than 4327

b) $(2 \times 10^4) + (4 \times 10^3) + (2 \times 10^2) + (4 \times 10^1)$
= (2 × 10 000) + (4 × 1000) + (2 × 100) + (4 × 10)
= 20 000 + 4000 + 200 + 40
= 24 240
24 240 is greater than 2432

c) $(7 \times 10^7) + (7 \times 10^3)$
= (7 × 10 000 000) + (7 × 1000)
= 70 000 000 + 7000
= 70 007 000
70 007 000 is greater than 777 777

14. a) One billion = 1 000 000 000
$= 10^9$

100 000 = 10^5

1000 = 10^3

1 = 10^0

100 = 10^2

10 million = 10 000 000
$= 10^7$

b) 1 (10^0), 100 (10^2), 1000 (10^3), 100 000 (10^5), 10 million (10^7), one billion (10^9)

c) To compare powers of 10, I need only compare their exponents; the least number has the least exponent.

15. Strategies may vary. For example:

I noticed earlier that the exponent of a power of 10 is equal to the number of zeros in the number. I also realized that trillion, quadrillion, and quintillion are the next three units after one billion, so I know that their exponents are multiples of 3.

I know that one million is one thousand thousands, or 10^6; one billion is one thousand millions, or 10^9.
So following that pattern, one trillion is one thousand billions, or 10^{12}, which is 1 followed by 12 zeros;
one quadrillion is one thousand trillions, or 10^{15}, which is 1 followed by 15 zeros; and
one quintillion is one thousand quadrillions, or 10^{18}, which is 1 followed by 18 zeros.